

IN THE CLAIMS:

Please cancel without prejudice claim 7.

Also kindly change claims 1 through 6, and claim 21, all to read as follows.

1       1. (currently amended) Apparatus for printing images on  
2       a printing medium, by construction from individual marks;  
3       said apparatus being characterized by a design value for  
4       printhead-to-printing-medium spacing (PPS), and  
5       comprising:

6               printheads carried on a scanning carriage next to a  
7       printing-medium position;

8               a single-channel optical sensor having:

9

10              plural lamps emitting substantially incoherent  
11              light,

12

13              means, including a photosensitive stage, for  
14              receiving and responding to the substantially incoherent light, and for developing  
15              therefrom a sensor output signal representing at least one difference between  
16              PPS measurements with a corresponding pair of the lamps;

17

18              said photosensitive stage being calibrated, with each of the plural lamps, at the design value of PPS; and  
19              means for interpreting the at least one difference signal as a PPS displacement from the design PPS value,  
20              to determine actual PPS in the printer

21

27        a platen locating such medium;  
28        at least one printhead marking on such medium;  
29        a carriage holding the head;  
30        a rod supporting the carriage for scanning motion  
31        across such medium;  
32        a sensor, at least partially mounted to the car-  
33        riage, measuring relative distances between the sensor  
34        and the platen or such medium; said sensor comprising  
35        first processor portions interpreting intensity of  
36        reflected radiation, at each of plural positions along  
37        the scanning motion respectively, as a measure of respec-  
38        tive transmission distances from the source to the sensor  
39        via reflection from the platen or such medium; and  
40        second microprocessor portions modifying the marking  
41        by the head to compensate for variation of the measured  
42        distances during the scanning motion.

1       2. (currently amended) The apparatus of claim 1, where-  
2       in:  
3                 the receiving and responding means comprise means  
4       for using the sensor with:  
5  
6                 the pair of lamps in alternation to develop an  
7                 a. c. signal output representing said at  
8                 least one difference, and  
9  
10                another pair of lamps in alternation to develop  
11                another a. c. signal output representing  
12                another difference;  
13  
14                the interpreting means comprise means for computing  
15       a mean of the differences; and  
16                the computing means comprise means for weighting the  
17       differences in an inverse relation to signal noise asso-  
18       ciated with each difference  
19  
20       the sensor further comprises:  
21               a radiation source emitting radiation toward the  
22       platen or such medium;  
23               a detector receiving source radiation reflected from  
24       the platen or such medium.

1       3. (currently amended) The apparatus of claim 1, fur-  
2       ther comprising:  
3               means for applying a signal from the sensor to com-  
4               pute a profile of said PPS along said scanning, using a  
5               known correlation function;  
6               means for measuring intensity variations of re-  
7               flected radiation received on the surface along said  
8               scanning;  
9               means for interpreting the intensity variations as  
10              directly due to attenuation in travel of the radiation  
11              toward the printing-medium position and back;  
12              means for retaining the interpreted intensity-varia-  
13              tion information for use in compensating imperfection;  
14              and  
15              means for adjusting marking positions of the print-  
16              heads, based on the computed PPS profile  
17  
18       wherein:  
19              the radiation source emits substantially incoherent  
20              radiation; and  
21              the sensor is a single-channel device.

1       4. (currently amended) A method of compensating opera-  
2       tion of a printer, which printer has printheads carried  
3       on a scanning carriage next to a printing-medium posi-  
4       tion; said method comprising the steps of:  
5               scanning a surface substantially at the printing-  
6       medium position using a single-channel, plural-lamp opti-  
7       cal sensor operating with substantially incoherent light;  
8               defining a design value for printhead-to-printing-  
9       medium spacing in the printer;  
10          calibrating the sensor, with each of plural lamps  
11       associated with the sensor, respectively, at the design  
12       PPS value;  
13          installing the calibrated sensor in the printer;  
14          operating the sensor, with each of the plural lamps  
15       respectively, in such a way as to develop a sensor output  
16       signal representing at least one difference between PPS  
17       measurements with a corresponding pair of the lamps; and  
18          interpreting the at least one difference signal as a  
19       PPS displacement from the design PPS value, to determine  
20       actual PPS in the printer  
21  
22       The apparatus of claim 1, wherein:  
23          the sensor comprises means for measuring the rela-  
24       tive distances without printing on such medium.

1       5. (currently amended) The method apparatus of claim 4  
2       [[1]], wherein:  
3                 the operating step comprises using the sensor with:  
4  
5                 the pair of lamps in alternation to develop an  
6                 a. c. signal output representing said at  
7                 least one difference; and  
8  
9                 another pair of lamps in alternation to develop  
10                 another a. c. signal output representing  
11                 another difference;  
12  
13                 the interpreting step comprises computing a mean of  
14                 the differences; and  
15                 the computing comprises weighting the differences in  
16                 an inverse relation to signal noise associated with each  
17                 difference  
18  
19                 the sensor comprises means for measuring the rela-  
20                 tive distances at multiple positions substantially along  
21                 the length of the rod.

1       6. (currently amended) The method apparatus of claim 4,  
2       further comprising the steps of:  
3               applying a signal from the sensor to compute a pro-  
4               file of said PPS along said scanning, using a known cor-  
5               relation function;  
6               measuring intensity variations of reflected radia-  
7               tion received on the surface along said scanning;  
8               interpreting the intensity variations as directly  
9               due to attenuation in travel of the radiation toward the  
10          printing-medium position and back;  
11          retaining the interpreted intensity-variation  
12          information for use in compensating imperfection; and  
13          adjusting marking positions of the printheads, based  
14          on the computed PPS profile

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16        i, wherein the modifying means comprise:  
17               memory storing the respective transmission-distance  
18               measures for the plural positions; and  
19               third microprocessor portions for retrieving the  
20               transmission-distance measures for the plural positions,  
21               to use in compensation, by the second portions, for cor-  
22               responding positions along the rod respectively.

1       7. (canceled)

1       8. (original) A method of compensating operation of a  
2       printer, which printer has printheads carried on a scan-  
3       ning carriage next to a printing-medium position; said  
4       method comprising the steps of:

5             scanning a surface substantially at the printing-  
6       medium position using a single-channel optical sensor  
7       operating with substantially incoherent light;

8             applying a signal from the sensor to compute a  
9       printhead-to-printing-medium spacing (PPS) profile along  
10      said scanning, using a known correlation function;

11          adjusting marking positions of the printheads, based  
12      on the computed PPS profile.

1       9. (original) The method of claim 8:

2             further comprising the step of loading unprinted,  
3       bare printing medium into the printer; and

4             wherein the surface-scanning step comprises scanning  
5       the unprinted, bare medium.

1       10. (original) A method of calibrating a printer, which  
2       printer has printheads carried on a scanning carriage  
3       next to a printing-medium position, and has a carriage  
4       support-and-guide rod subject to imperfection in geomet-  
5       rical relation with the printing-medium position; said  
6       method comprising the steps of:

7              projecting radiation from the carriage toward the  
8       printing-medium position for reflection back toward the  
9       carriage, at plural locations of the carriage along the  
10      rod;

11             measuring intensity variations of reflected radia-  
12       tion received on the carriage at the plural locations;

13             interpreting the intensity variations as directly  
14       due to attenuation in travel of the radiation through the  
15       distance from the carriage toward the printing-medium  
16       position and back to the carriage; and

17             retaining the interpreted intensity-variation infor-  
18       mation for use in compensating the imperfection.

1       11. (original) The method of claim 10, wherein:

2             the projecting step comprises projecting the radia-  
3       tion to a printing medium disposed at the printing-medium  
4       position;

5             the measuring step comprises receiving the radiation  
6       reflected from the printing medium; and

7             the attenuation is due to scattering of the radia-  
8       tion in the reflection, and divergence of the radiation  
9       during said travel.

1       12. (original) The method of claim 11, wherein, during  
2       said projecting and receiving :  
3                substantially nothing has been printed on the print-  
4       ing medium;  
5                whereby the printing medium is substantially bare  
6       printing medium.

1       13. (original) The method of claim 10, wherein:  
2                the projecting step comprises projecting the radia-  
3       tion to a platen disposed substantially at the printing-  
4       medium position; and  
5                the measuring step comprises receiving the radiation  
6       reflected from the platen.

1       14. (original) The method of claim 13, wherein:  
2                the interpreting step comprises making a distance  
3       allowance for thickness of printing medium absent from  
4       the platen.

1       15. (original) The method of claim 10, wherein:  
2                the interpreting step comprises referring to a  
3       previously determined correlation function between inten-  
4       sity variation information and printhead-to-printing-  
5       medium spacing.

1       16. (original) A method of determining printhead-to-  
2       printing-medium spacing (PPS) in an incremental printer,  
3       using a plural-lamp sensor; said method comprising the  
4       steps of:

5               defining a design value for PPS in the printer;  
6               calibrating the sensor, with each lamp of the  
7       plurality respectively, at the design PPS value;  
8               installing the calibrated sensor in the printer;  
9               operating the sensor, with each lamp of the plural-  
10      ity respectively, in such a way as to develop a sensor  
11      output signal representing at least one difference be-  
12      tween PPS measurements with a corresponding pair of the  
13      lamps; and  
14               interpreting the at least one difference signal as a  
15      PPS displacement from the design PPS value, to determine  
16      actual PPS in the printer.

1       17. (original) The method of claim 16, wherein the  
2       operating step comprises:

3               using the sensor with the pair of lamps in alterna-  
4      tion to develop an a. c. signal output representing said  
5      at least one difference.

1       18. (original) The method of claim 17, wherein:  
2               the operating step further comprises using the sen-  
3      sor with another pair of lamps in alternation to develop  
4      another a. c. signal output representing another differ-  
5      ence; and  
6               the interpreting step comprises computing a mean of  
7      the differences.

1       19. (original) The method of claim 18, wherein:  
2                  the computing comprises weighting the differences in  
3                  an inverse relation to signal noise associated with each  
4                  difference.

1       20. (original) The method of claim 19, wherein:  
2                  the computing comprises finding said mean as a root-  
3                  mean-square of the weighted differences.

1       21. (currently amended) Apparatus for printing an image  
2       on a printing medium, by construction from individual  
3       marks; said apparatus comprising:  
4              a platen locating such medium;  
5              an array of printing elements marking on such  
6       medium, said array being of length at least as great as  
7       width of such image;  
8              an advance mechanism providing relative motion of  
9       such medium and the array, substantially at right angles  
10      to the array length;  
11             a carriage scanning lengthwise along the array;  
12             a sensor, at least partially mounted to the car-  
13      riage, measuring relative distances between the sensor  
14      and the platen or such medium; said sensor comprising  
15      first processor portions interpreting intensity of  
16      reflected radiation, at each of plural positions along  
17      the scanning motion respectively, as a measure of respec-  
18      tive transmission distances from a [[the]] source to the  
19      sensor via reflection from the platen or such medium; and  
20             second microprocessor portions modifying the marking  
21      by the array to compensate for variation of the measured  
22      distances along the array length.

1       22. (original) The apparatus of claim 21, wherein:  
2             the carriage carries exclusively the sensor or por-  
3      tions thereof, not the array.